

*The following two reports deal with 316 infections due to Pasteurella multocida. In addition 149 human cases were found in the literature. In relation to cases with no animal contact, a reservoir of P. multocida infection in man with interhuman transmission is postulated.*

## I. PASTEURELLA MULTOCIDA INFECTION DUE TO ANIMAL BITE

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### Introduction

SEVENTY-SEVEN reports of *Pasteurella multocida* infection due to animal bite were found in the medical literature to 1965. These included exposure to cats in 41 instances,<sup>1-19</sup> dogs in 14 instances,<sup>2,5,10,19-24</sup> and single cases resulting from lion,<sup>25</sup> panther,<sup>26</sup> and rabbit bite,<sup>27</sup> respectively (Table 1). There were 19 additional cases that were reported briefly without clinical histories that included 15 dog bites<sup>28,29</sup> and four from cats.<sup>19</sup> It would appear that disease due to this organism is relatively uncommon with such a dearth of reports in the literature. However, we are dealing with infections with no mandatory requirements for reporting their occurrence, and only cases of unusual interest may have been published.

This paper summarizes the epidemiologic data gathered on 180 cases resulting from animal bite which occurred in the United States from May, 1965, through March, 1968.

### Materials and Methods

Data were gathered as previously described.<sup>30</sup> History requests included the offending animal, date and location of bite, and age and sex of patient. Identification of *P. multocida* strains was done as previously described.<sup>30</sup>

### Results

Cultures of *P. multocida* from animal bite wounds were submitted from 28

states and the District of Columbia (Table 2). Eighty (45%) of these isolates came from California. The sources of infection were as follows: 111 cats, 65 dogs, 1 both cat and dog, 1 lion, 1 opossum, and 1 rat (Table 2).

Distribution of the bite lesions ranged from the face to the foot (Table 3). The most common location was the upper extremity (62%). Thirty-four of 40 leg bites were from cats (1 was due to both cat and dog). Twenty-three of 27 head or eye wounds resulted from dog bites. In one case, wounds inflicted by a dog on both the arm and leg were infected. Although, for convenience, these cases have been summarized as animal bites, it should be noted that some cat-induced wounds were not the result of bites. Cat scratches accounted for 20/111 and the wounds of 11/111 resulted from combined bites and scratches. For example, a five-year-old boy became infected after a cat scratch on the cornea.

There were 33 more female cases than male resulting from cat bites and 1 more female case than male from dog bites (Table 4). The lone lion and opossum bite victims were males, whereas the rat bite patient was female.

Of the 180 persons, only 57 (32%) were 19 years of age or younger, whereas 94 (52%) were 40 years of age or older (Table 4). In fact, 37 (21%) persons were 65 years or older. Sixty-two per cent of 111 patients with cat bites were over 40 years of age,

**Table 1—Reported cases of *P. multocida* infection in the literature due to animal bite by age, sex, and offending species**

Age	Cat		Dog		Other		Total
	M	F	M	F	M	F	
0-19	2	2	2	1			7
20-39		4		2			6
40-59	6	8	1	4	1 <sup>c</sup>		20
60+	3	9	2				14
Adult	2	4	1		2 <sup>a,b</sup>		9
Unknown	1			1			2
Total	14	27	6	8	3		58

a,b—1 lion, 1 panther.  
c—1 rabbit.

**Table 2—Reported cases of *P. multocida* infection due to animal bite by geographic area, sex, and offending species in the U. S. (May, 1965, through March, 1968)**

Area (state)	Sex of case		Offending species			Total
	M	F	Cat	Dog	Other	
New England (Me., Mass.)	1	6	5	2	0	7
Middle Atlantic (N. J., N. Y., Pa.)	10	9	11	8	0	19
East North Central (Ill., Ind., Mich., Ohio, Wis.)	3	13	9	7	0	16
West North Central (Minn., Mo.)	4	2	4	2	0	6
South Atlantic (Del., D. C., Fla., Ga., Md., N. C., Va.)	13	10	14	8	1 rat (Md.)	23
East South Central (Ala., Miss.)	3	1	0	3	1 opossum	4
West South Central (Ark., La.)	1	1	1	1	0	2
Mountain (Ariz., Colo., Mont., N.M.)	8	10	11	7	0	18
Pacific (Calif., Ore.)	30	55	56	27	1 lion (Calif.) 1 both dog & cat	85
Total	73	107	111	65	4	180

compared to 34 per cent of the 65 who suffered dog bites.

Although one or more cases of *P. multocida* infection resulting from exposure to cats or dogs occurred in each month of the year, the number was slightly higher from July through September (Table 5). This pattern resulted

at least in part from the period of time included in the study.

#### Comment

Response to the requests which were circulated permits the conclusion that *P. multocida* infection resulting from animal bite undoubtedly occurs frequently

**Table 3—Anatomic location of 180 *P. multocida* infections reported in the U. S. (May, 1965, through March, 1968)**

Location of bite lesion	Offending animal		
	Cat	Dog	Other
Upper extremity	74	35	1 rat, 1 opossum
Lower extremity	33	6	1 cat and dog
Head and neck	3(2)	23(1)	
Both extremities		1	
Eye	1		
Head and thorax			1 lion
	—	—	—
Total	111	65	4

(1) All face bites.

(2) 1 scalp scratch (infant).

in the United States. Reports from 28 states, limited by prior submission of a culture, yielded approximately twice as many cases as were found in the literature. If one considers the thousands of bites that are reported in this country annually, the possibility of at least several hundred infections each year seems likely. Lee and Buhr<sup>29</sup> found that 10 out of 20 infected dog bites in a series of 69 cases were due to *P. multocida*. They isolated the organism from wounds of 2 other patients who did not develop frank infection. It has been found

that, among animal populations sampled, *P. multocida* is a common member of the oral flora, with figures as high as 67 per cent in cats (Bitterroot Valley, Montana),<sup>31</sup> 54 per cent in dogs (London, England),<sup>32</sup> and 14 per cent in wild rats (Baltimore, Maryland).<sup>33</sup> The lack of reports from 22 states certainly does not reflect absence of the organism in those areas.

In studies of the anatomic location of dog bites,<sup>34-36</sup> approximately 70 per cent were found distributed between the upper and lower extremities, with the latter favored slightly. Another 20 per cent involved the head, face, and neck (Table 6). Infections due to *P. multocida* from dogs found in this study involved the head more often and the lower extremities less often than expected. Unfortunately, no such studies of the epidemiology of cat bites are available for comparison. The cases due to cat bites have a similar distribution for the limbs but there are remarkably fewer reports involving the face than for dogs. If studies on the epidemiology of cat bites similar to those quoted for dogs were available, it would be easier to assess the pattern of infections due to cat bite. Cat scratches as well as bites may become infected. This is not surprising as the habit of cats to lick their paws frequently while grooming them-

**Table 4—*P. multocida* infections by age and sex of cases and offending species**

Age	Cat		Dog		Other		Total
	M	F	M	F	M	F	
0-19	12	11	16	17	1 lion		57
20-39	7	12	8	2			29
40-59	8	33	6	9	1 rat		57
60+	12	16	2	5	1(a)	1(b)	37
	—	—	—	—	—	—	—
Total	39	72	32	33	2	2	180

(a) opossum.

(b) dog and cat.

**Table 5—*P. multocida* infections by season of bite (May, 1965, through March, 1968)**

Season	Cat				Dog			Other		Total
	'65	'66	'67	'68	'65	'66	'67	'66	'67	
Jan.-Mar.	—	11	14	11	—	4	7	1 rat		48
Apr.-June	2	12	1	—	2	9	3			29
July-Sept.	16	14	8	—	6	15	2			61
Oct.-Dec.	6	8	7	—	5	10	2	1 lion, 1 opossum	1 cat and dog	41 1
Unknown	1									
Total	25	45	30	11	13	38	14	3	1	180

selves would permit contamination of the claws with organisms in the saliva.

If *P. multocida* infection after dog bite were related strictly to exposure, then we would expect approximately 70 per cent in males and at least 75 per cent in children (under 20 years).<sup>35,36</sup> However, just over one-half of the infections were among females, and only 51 per cent (33/65) among children. Although the numbers are small, it appears that mechanisms other than exposure may also affect the development of infection. These differences are even more noticeable among the cases resulting from cat bite in which 65 per cent were females and only 21 per cent were children. Without data on the epidemiology of cat bites, one can speculate only on the reasons for the large number of cases in persons over 65. The

obvious conclusion would be a greater exposure potential. However, it would certainly be of interest if some factor did affect a differential susceptibility related to aging.

Lee and Buhr,<sup>29</sup> as well as Smith,<sup>38</sup> suggested that *P. multocida* infections from dog bites might be more common during the winter. On the other hand, at least 70 per cent of all dog bites are reported to occur during the spring and summer (April-September).<sup>36,37</sup> However, there is little evidence from our data to support any seasonal pattern other than that related to exposure.

The ratio of infected bites resulting from exposure to the various animal species is remarkable. A five-year study of hospital emergencies, 1.84 per cent of which were animal bites, reported that 90.1 per cent of the bites were from

**Table 6—Anatomic location of dog bites compared with the site of infection with *P. multocida* following cat and dog bites**

Location of bite	Reported studies of dog bites (%)	<i>P. multocida</i> infections % (No.)	
		Dog	Cat
Upper extremities	30.7-37.0	54.0 (35)	66.6 (74)
Lower extremities	39.0-43.1	9.2 (6)	30.0 (33)
Head, face, and neck	16.0-25.0	35.4 (23)	3.6 (4)
Trunk	3.5- 8.0	0	0
Upper and lower extremities		1.9 (1)	0

dogs.<sup>34</sup> In a group of 157 children treated for mammalian bites, dogs were responsible for 84.1 per cent, cats 4.4 per cent, whereas eight other species were included in the remaining 10.5 per cent.<sup>39</sup> Inasmuch as there are more infections reported from exposure to cats, it seems the chances of becoming infected from this source are at least ten times greater than from dogs. However, it is possible that there is considerably more exposure to cat scratches which would not be included in the bite statistics and, for that matter, probably would not require medical attention unless complicated by infection. Although cats and dogs have been emphasized, it is well to remember that other species may transmit *P. multocida* by bite as well. Three other species have previously been reported to be responsible for infections in man (lion, panther, rabbit). The opossum and rat can now be added to the list of sources, as well as a second example of infection resulting from the bite of a lion.

It is interesting that earlier reports of *P. multocida* infections due to rat bite were not found, particularly since 322 rat bite cases were investigated in Baltimore, Maryland, alone during 1948-1952.<sup>40</sup> In this same city it had been determined that 14 per cent of the rats were carrying the organism.<sup>33</sup> Among these cases, 229 (71%) bites were on the extremities and 231 (72%) occurred among children who were 12 years old or younger. There was no obvious seasonal pattern.

Since *P. multocida* does occur frequently as part of the flora of the mouth and throat of animals in close association with man, this type of zoonosis must be recognized as a common sequel to animal bite.

### Summary

Seventy-seven cases of *P. multocida* infection due to animal bite were found

in the literature, including 45 persons exposed to cats, 29 to dogs, and single cases resulting from lion, panther, and rabbit bite, respectively. One hundred and eighty cases are reported in this study. The offending animals were 111 cats, 65 dogs, 1 both cat and dog, a lion, an opossum, and a rat.

*P. multocida* infection in man due to animal bite occurs frequently. Cat scratches, as well as bites, are important sources. Infection is more common among older persons. Although dog bites are more prevalent during the warmer months, wounds infected with *P. multocida* have occurred with equal frequency throughout the year.

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